UNIT 2 **WATER & SOLUTION REVISION QUESTIONS** **CHEMISTRY**

1. Which of the following processes is **not** required for a substance to dissolve in water:
A. ionisation of covalent substances. B. dissociation of ionic substances.
C. formation of dispersion forces between molecules. D. formation of hydrogen bonds between molecules.

2. The presence of hydrogen bonds between molecules explains the following properties **except** for:
A. higher M.P. and B.P. B. expansion upon freezing.
C. solubility of polar substances. D. electrical conductivity.

3. The order in which the amount of solute increases in the following types of solutions is:
A. supersaturated, saturated, concentrated, dilute. B. dilute, concentrated, saturated, supersaturated.
C. saturated, supersaturated, dilute, concentrated. D. dilute, saturated, concentrated, supersaturated.

4. If 24 g of $NaNO_3$ dissolves in 100 g of water at 30 ^oC then at 60 ^0C, the mass of $NaNO_3$ that should dissolve is:
A. 48 g. B. 24 g. C. unknown without a graph. D. 12 g.

5. The reason why some hydrocarbons do not dissolve or mix with water is because the hydrocarbon is:
A. polar. B. non polar. C. ionic. D. combustible.

6. Which one of the following is likely to be insoluble in water:
A. NaOH. B. $NaNO_3$. C. $Fe(OH)_2$. D. $Fe(NO_3)_2$.

7. If there are 0.02 g of Mercury in 1.0 L (1000 g) of water, then the amount of Mercury in ppm is:
A. 0.02. B. 0.20. C. 2.0. D. 20.

8. The ionic equation for the reaction HCl(aq) + NaOH(aq) ---> NaCl(aq) + H_2O(l) is:
A. Cl^-(aq) + Na^+(aq) --> NaCl(aq). B. OH^-(aq) + H^+(aq) --> H_2O(l).
C. Cl^-(aq) + H^+(aq) --> HCl(aq). D. OH^-(aq) + Na^+(aq) --> NaOH(aq).

9. Which of the following will form a precipitate with Chloride ions (Cl^-):
A. Sodium ions, Na^+. B. Calcium ions, Ca^{2+}. C. Aluminium ions, Al^{3+}. D. Lead ions, Pb^{2+}.

10. The amount (in mol) of NaCl present in 200 mL of 0.10 M NaCl solution is:
A. 20 mol. B. 2.0 mol C. 0.020 mol. D. 5.0 x 10^{-4} mol.

11. Define the following terms:
a). Miscible. b). Supersaturated.

c). Immiscible. d). Homogenous solution.

e). Ionisation. f). Dissociation.

12. Convert the following measurements into the concentration unit that is listed in the question:
a). 75 g of salt in a 250 g solution as a % w/w. b). 125 mL of Chlorine in a 500.0 mL solution as a % v/v.
c). 28 g of alcohol in a 200.0 mL solution as a % w/v. d). 5 g of DDT in a 500,000 g sample as ppm.
e). 0.30 mol of NaCl in 1.5 L solution as a Molarity. f). 4.0 g of salt in 250 mL solution as g/L.

13. a). Determine the mass of salt present in a 250 mL flask containing a 0.20 %w/v salt solution.
b). Determine the mass of DDT present in a 1000 g sample whose concentration of DDT is 400 ppm.
c). Determine the total volume of solution required to prepare a 5.0 % w/v salt solution containing 10 g of salt.
d). Determine the concentration in ppm of a 200 mL solution with density 1.1 g/mL containing 0.011 g of salt.

14. Use mol formula to fill in the following table: Ar(Na) = 23, Ar(Cu) = 63.5, Ar(Ag) = 108, Ar(Cl) = 35.5, Ar(H) = 1, Ar(O) = 16, Ar(C) = 12, Ar(S) = 32, Ar(N) = 14.

Item	Amount in mol	Mass of Solute	Volume of Solution	Solute Concentration
a).	1.00 mol NaCl solute			0.100 M NaCl solution
b).		1.70 g $AgNO_3$ solute		1.0 M $AgNO_3$ solution
c).			150 mL NaOH solution	0.60 M NaOH solution

Answers: 1. C. 2. D. 3. B. 4. C. 5. B. 6. C. 7. D. 8. B. 9. D. 10. C. 11. See Lecture Notes. 12. a). 30 % w/w. b). 25.0 % v/v. c). 14 % w/v. d). 10 ppm. e). 0.20 M. f). 16 g/L. 13a). 0.5 g. b). 0.4 g c). 200 mL. d). 50 ppm. 14. a). 58.5 g, 10.0 L. b). 0.010 mol, 1.0 x 10^1 mL. c). 0.090 mol, 3.6 g.

UNIT 2 **IONS & SOLUTION REVISION QUESTIONS** **CHEMISTRY**

1. Use Electron Dot diagrams to show the arrangement of valence electrons in the following compounds.

a). LiF.

Li + F --->

b). K_2O.

--->

2. List and explain 3 ways in which substances can be made to dissolve in water.

a). b). c).

3. Balance the following Molecular equations:

a). $NaOH(aq) + Cu(NO_3)_2(aq) \rightarrow NaNO_3(aq) + Cu(OH)_2(s)$.

b). $LiCl(aq) + Pb(NO_3)_2(aq) \rightarrow LiNO_3(aq) + PbCl_2(s)$.

c). $Al(NO_3)_3(aq) + LiOH(aq) \rightarrow LiNO_3(aq) + Al(OH)_3(s)$.

d). $Na_2SO_4(aq) + CaCl_2(aq) \rightarrow CaSO_4(s) + NaCl(aq)$.

e). $Ca(NO_3)_2(aq) + Al_2(SO_4)_3(aq) \rightarrow CaSO_4(s) + Al(NO_3)_3(aq)$.

f). $FeCl_3(aq) + Pb(NO_3)_2(aq) \rightarrow Fe(NO_3)_3(aq) + PbCl_2(s)$.

4. Determine the products, then rewrite the following using Chemical formulae & balance the Molecular Equations:

a). Sodium Chloride reacts with Silver Nitrate.

b). Silver Nitrate reacts with Hydrogen Chloride

c). Copper Sulfate reacts with Calcium Chloride.

d). Lead(II) Nitrate reacts with Sodium Chloride

e). Calcium Chloride reacts with Sodium Sulfate

f). Copper Nitrate reacts with Potassium Hydroxide

g). Sulfuric Acid (H_2SO_4) + Potassium Carbonate.

h). Nitric Acid (HNO_3) reacts with Lithium Oxide.

5. Use the Solubility Table (Page 199 Textbook or Page 5 Lecture Notes) to complete the following table:

Reactants	Ions present	Precipitate	Spectator Ions
a). Sodium Chloride reacts with Silver Nitrate			
b). Potassium Carbonate reacts with Copper Chloride			
c). Copper Nitrate reacts with Sodium Hydroxide			
d). $Na_2CO_3 + BaCl_2$			
e). $CuSO_4 + K_2CO_3$			
f). $Pb(NO_3)_2 + LiCl$			
g). $LiOH + FeCl_3$			
h). $MgCl_2 + NH_4NO_3$			
i). $KCl + NaNO_3$			

6. Write Ionic Equations for the precipitation reactions that occurred in question 5.

7. Write Ionic Equations for each of the following:

a). Hydrochloric Acid reacts with Magnesium Oxide.

b). Copper Oxide reacts with Sulfuric Acid.

c). Hydrochloric Acid reacts with Strontium Hydroxide.

d). Sulfuric Acid reacts with Lithium Hydroxide.

e). Hydrochloric Acid reacts with Sodium Carbonate.

f). Nitric Acid reacts with Lithium Carbonate.

ANSWERS: 1a). Donate 1 e^- from the 1 outershell e- of Li to the 7 outershell e- of F to produce Li^+ and F^{--}. b). Donate 1 e^- from each of the 1 outershell e- of K to the 6 outershell e- of O to produce 2 K^+ and O^{2-}. 2. Dissociation, Ionisation, Polar Molecules forming H bonds.
3 a). $2 NaOH(aq) + Cu(NO_3)_2(aq) \rightarrow 2 NaNO_3(aq) + Cu(OH)_2(s)$. b). $2 LiCl(aq) + Pb(NO_3)_2(aq) \rightarrow 2 LiNO_3(aq) + PbCl_2(s)$.
c). $Al(NO_3)_3(aq) + 3 LiOH(aq) \rightarrow 3 LiNO_3(aq) + Al(OH)_3(s)$. d). $Na_2SO_4(aq) + CaCl_2(aq) \rightarrow CaSO_4(s) + 2 NaCl(aq)$. e). $3 Ca(NO_3)_2(aq) + Al_2(SO_4)_3(aq) \rightarrow 3 CaSO_4(s) + 2 Al(NO_3)_3(aq)$. f). $2 FeCl_3(aq) + 3 Pb(NO_3)_2(aq) \rightarrow 2 Fe(NO_3)_3(aq) + 3 PbCl_2(s)$. 4a). $NaCl(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NaNO_3(aq)$.
b). $AgNO_3(aq) + HCl(aq) \rightarrow AgCl(s) + HNO_3(aq)$. c). $CuSO_4(aq) + CaCl_2(aq) \rightarrow CaSO_4(s) + CuCl_2(aq)$. d). $Pb(NO_3)_2(aq) + 2 NaCl(aq) \rightarrow PbCl_2(s) + 2 NaNO_3(aq)$. e). $CaCl_2(aq) + Na_2SO_4(aq) \rightarrow CaSO_4(s) + 2 NaCl(aq)$. f). $Cu(NO_3)_2(aq) + 2 KOH(aq) \rightarrow Cu(OH)_2(s) + 2 KNO_3(aq)$. g). $H_2SO_4(aq) + K_2CO_3(aq) \rightarrow H_2O(l) + CO_2(g) + 2 K_2SO_4(aq)$. h). $2 HNO_3(aq) + Li_2O(aq) \rightarrow 2 LiNO_3(aq) + H_2O(l)$. 5. a). Na^+, Ag^+, NO_3^-, Cl^-; AgCl; Na^+, NO_3^- b). K^+, CO_3^{2-}, Cu^{2+}, Cl^-; $CuCO_3$; K^+, Cl^-. c). Cu^{2+}, NO_3^-, Na^+, OH^-; $Cu(OH)_2$; Na^+, NO_3^-. d). Na^+, CO_3^{2-}, Ba^{2+}, Cl^-; $BaCO_3$; Na^+, Cl^-. e). Cu^{2+}, SO_4^{2-}, K^+, CO_3^{2-}; $CuCO_3$; K^+, SO_4^{2-}. f). Pb^{2+}, NO_3^-, Li^+, Cl^-; $PbCl_2$; Li^+, NO_3^-. g). Li^+, OH^-, Fe^{3+}, Cl^-; $Fe(OH)_3$; Li^+, Cl^-. h). Mg^{2+}, Cl^-, NH_4^+, NO_3^- no precipitate, all Spectator ions. i). K^+, Cl^-, Na^+, NO_3^-, no precipitate, all Spectator ions. 6a). $Ag^+(aq) + Cl^-(aq) \rightarrow AgCl(s)$. b). $CO_3^{2-}(aq) + Cu^{2+}(aq) \rightarrow CuCO_3(s)$. c). $Cu^{2+}(aq) + 2 OH^-(aq) \rightarrow Cu(OH)_2(s)$. d). $CO_3^{2-}(aq) + Ba^{2+}(aq) \rightarrow BaCO_3(s)$. e). $Cu^{2+}(aq) + CO_3^{2}(aq) \rightarrow CuCO_3(s)$. f). $Pb^{2+}(aq) + 2 Cl^-(aq) \rightarrow PbCl_2(s)$. g). $3 OH^-(aq) + Fe^{3+}(aq) \rightarrow Fe(OH)_3(s)$.
6h) & 6i). No Eqn. 7a). $2 H^+(aq) + O^{2-}(aq) \rightarrow H_2O(l)$. b). $2 H^+(aq) + O^{2-}(aq) \rightarrow H_2O(l)$. c). $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$. d). $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$.
e). $2 H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g)$. f). $2 H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g)$.

UNIT 2 **ACID/BASE REVISION I QUESTIONS** **CHEMISTRY**

1. The chemical species that an acid donates to a base is:
A. $H^+(aq)$. B. $OH^-(aq)$. C. $H_2O(l)$. D. $H_2(g)$.

2. Compared to a weak acid, a strong acid will:
A. have more H^+ ions. B. have less H^+ ions.
C. be able to donate H^+ more readily. D. be able to donate H^+ less readily.

3. An amphiprotic species or ampholyte can:
A. only donate protons. B. only donate $OH^-(aq)$ ions.
C. either donate or accept $H^+(aq)$ ions. D. either donate or accept $OH^-(aq)$ ions.

4. Which of the following is **not** an acid/base reaction:
A. $HCl(aq) + NaOH(aq) \rightarrow NaCl(aq) + H_2O(l)$. B. $HCl(aq) + H_2O(l) \rightarrow Cl^-(aq) + H_3O^+(aq)$.
C. $HCl(aq) + NH_3(aq) \rightarrow NH_4^+(aq) + Cl^-(aq)$. D. $2\ HCl(aq) + Mg(s) \rightarrow MgCl_2(aq) + H_2(g)$.

5. In order of donating protons, Monoprotic, Diprotic and Triprotic acids can donate:
A. 3, 2, 1 H^+ ions. B. 1, 2, 3 H^+ ions. C. 1, 2, 3 OH^- ions. D. 3, 2, 1 OH^- ions.

6. The pH of a base is always:
A. greater than 7. B. greater than 15. C. less than 7. D. less than 0.

7. The pH of a 0.001 M solution of HCl is:
A. 1. B. 3. C. 7. D. 11.

8. The concentration of $H^+(aq)$ ions in a solution of pH 4 is:
A. 1×10^{-4} M. B. 1×10^{4} M. C. 1×10^{-10} M. D. 1×10^{10} M.

9. The concentration of $OH^-(aq)$ ions in a solution of pH 4 is:
A. 1×10^{-4} M. B. 1×10^{4} M. C. 1×10^{-10} M. D. 1×10^{10} M.

10. Which reaction equation represents an acid reacting with a metal oxide:
A. $H_2SO_4(aq) + 2\ NaCl(aq) \rightarrow 2\ HCl(aq) + Na_2SO_4(aq)$. B. $H_2SO_4(aq) + 2\ Na_2O(aq) \rightarrow 2\ H_2O(l) + Na_2SO_4(aq)$.
C. $HCl(aq) + H_2O(l) \rightarrow Cl^-(aq) + H_3O^+(aq)$. D. $2\ HCl(aq) + Na_2S(aq) \rightarrow H_2S(g) + 2\ NaCl(aq)$.

11. When dilute Sulfuric acid is added to a solid, a colourless gas with a rotten egg odour is produced. The solid is a:
A. Chloride. B. Sulfide. C. Sulfate. D. Nitrate.

12. When Sodium Hydroxide is added to Nitric Acid, one of the products is:
A. Sodium Nitrate. B. Sodium Nitrite. C. Nitrous Oxide, NO. D. Nitrogen Dioxide, NO_2.

13. Which of the following is likely to have the lowest pH:
A. a dilute weak acid. B. a dilute strong acid. C. a concentrated strong base. D. a dilute weak base.

14. Write a reaction to show HSO_4^- acting as amphiprotic substance.

15. Write balanced equations for:
a). acid reacting with a reactive metal. b). a reaction between a metal carbonate and an acid.
c). a diprotic acid donating its protons is 2 stages. d). a weak acid (CH_3COOH) donating its proton.

16. Determine the pH for each of the following:
a). 0.01 M HCl. b). 1×10^{-3} M HCl. c). 0.01 M NaOH. d). 5×10^{-7} M $Ca(OH)_2$.

17. a). Explain the difference between a dilute acid and a weak acid.
b). Identify the acids in the following reaction: $HCl(aq) + H_2O(l) \rightarrow Cl^-(aq) + H_3O^+(aq)$.
c). Identify the Conjugate acid of OH^-.
d). Identify the Conjugate base of HSO_4^-.
e). The Conjugate acid/base pairs in the reaction: $HCl(aq) + H_2O(l) \rightarrow Cl^-(aq) + H_3O^+(aq)$.

18. Write the ionic equation for the reaction: $CaCO_3(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$.

19. a). Determine the resultant pH if 100 mL of acid of pH 3 is diluted to 1000 mL by adding 900 mL of water.
a). Determine the resultant pH if 10 mL of base of pH 10 is diluted to 1000 mL by adding 990 mL of water.

Multiple Choice Answers: 1. A. 2. C. 3. C. 4. D. 5. B. 6. A. 7. B. 8. A. 9. C. 10. B. 11. B. 12. A. 13. B.
14. $HSO_4^-(aq) + H_2O(l) \rightarrow H_2SO_4(aq) + OH^-(aq)$ and $HSO_4^-(aq) + H_2O(l) \rightarrow SO_4^{2-}(aq) + H_3O^+(aq)$.
15. Acid reactions: a). $Ca(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + H_2(g)$. b). $CaCO_3(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$.
c). $H_2SO_4(aq) + H_2O(l) \rightarrow HSO_4^-(aq) + H_3O^+(aq)$ then $HSO_4^-(aq) + H_2O(l) \Leftrightarrow SO_4^{2-}(aq) + H_3O^+(aq)$
d). $CH_3COOH(aq) + H_2O(l) \Leftrightarrow CH_3COO^-(aq) + H_3O^+(aq)$.
16. pH: a). 2. b). 3. c). 12. d). 8. 16.a). Dilute acid can be weak or strong but is watered down and a weak acid cannot readily donate protons.
17 b). HCl and H_3O^+. c). H_2O. d). SO_4^{2-}. e). $HCl(aq)/Cl^-(aq)$ and $H_3O^+(aq)/H_2O(l)$. 18. $CaCO_3(s) + 2\ H^+(aq) \rightarrow Ca^{2+}(aq) + H_2O(l) + CO_2(g)$. 19. a). 4. b). 8.

UNIT 2 **ACID/BASE REVISION II QUESTIONS** **CHEMISTRY**

1. Complete the following sentences:

a). Acids are proton _____ and produce ____ ions. Their solutions have a pH _____ than 7.

b). Bases are proton _____ and produce ____ ions. Their solutions have a pH _____ than 7.

c). The general equation for Neutralisation is: ACID + BASE --> _____ + _____.

d). A _____ arrow is used to represent a reaction that does not go to completion.

2. Write full balanced equations for the following reactions:

a). ___ HCl(aq) + ___ KOH(aq) -->

b). ___ $Ca(OH)_2$(s) + ___ HNO_3(aq) -->

c). ___ H_2SO_4(aq) + ___ NaOH(aq) -->

d). ___ LiOH(aq) + ___ H_3PO_4(aq) -->

3. Write Ionic equations for each of the above reaction equations:

a).

b).

c).

d).

4. Write the acid/base conjugate pairs for the reactions:

a). $HF(aq) + H_2O(l) \rightarrow F^-(aq) + H_3O^+(aq)$.

ACID/BASE Pair 1:

ACID/BASE Pair 2:

b). $SO_4^{2-}(aq) + H_2O(l) \rightarrow HSO_4^-(aq) + OH^-(aq)$.

ACID/BASE Pair 1:

ACID/BASE Pair 2:

5. Explain the following terms:

a). Indicator. b). Strong Acid. c). Dissociation. d). Ionisation.

6. Determine the type of acid reaction occurring in each of the following (Acid and Metal, Acid and Metal Oxide, Acid and Metal Carbonate, Acid and Metal Sulfite and Acid and Metal Sulfide) and then write full balanced equations for the reactions.

Reaction	Reaction Type	Full Balanced Equation
a). $HCl(aq) + Li_2O(aq) \rightarrow$		
b). $H_2SO_4(aq) + Zn(s) \rightarrow$		
c). $H_3PO_4(aq) + K_2CO_3(aq) \rightarrow$		
d). $HNO_3(aq) + K_2S(aq) \rightarrow$		
e). $HF(aq) + CaSO_3(aq) \rightarrow$		

7. For each of the previous reactions, write the ionic equations for the reaction:

a).

b).

c).

d).

e).

8. Determine the names of the following chemicals:

a). HCl. b). H_2SO_4. c). CH_3COOH. d). NaOH.

e). $Ca(OH)_2$. f). NH_3. g). H_2S. h). H_2O.

Answers: 1a). donors, H^+, less. b). acceptors, OH^-, greater. 2a). $HCl(aq) + KOH(aq) \rightarrow H_2O(l) + KCl(aq)$.
b). $Ca(OH)_2(s) + 2\ HNO_3(aq) \rightarrow Ca(NO_3)_2(aq) + 2\ H_2O(l)$. c). $H_2SO_4(aq) + 2\ NaOH(aq) \rightarrow Na_2SO_4(aq) + 2\ H_2O(l)$.
d). $3\ LiOH(aq) + H_3PO_4(aq) \rightarrow Li_3PO_4(aq) + 3\ H_2O(l)$. 3a). $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$. b). $Ca(OH)_2(s) + 2\ H^+(aq) \rightarrow Ca^{2+}(aq) + 2\ H_2O(l)$.
c). $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$. d). $H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$. 4a). $HF(aq)/F^-(aq)$, $H_3O^+(aq)/H_2O(l)$. b). $HSO_4^-(aq)/SO_4^{2-}(aq)$, $H_2O(l)/OH^-(aq)$.
5a). an indicator is a dye that changes colour according to the pH of a solution. b). A strong acid completely dissociates/releases its H^+ ions. c). Dissociation is the process of an ionic species splitting into separate cations and anions. d). Ionisation is the process of a polar species reacting to form ions (cations & anions).
6a). Acid & Metal Oxide: $2\ HCl(aq) + Li_2O(aq) \rightarrow H_2O(l) + 2\ LiCl(aq)$. b). Acid & Metal: $H_2SO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + H_2(g)$.
c). Acid & Metal Carbonate: $2\ H_3PO_4(aq) + 3\ K_2CO_3(aq) \rightarrow 2\ K_3PO_4(aq) + 3\ CO_2(g) + 3\ H_2O(l)$. d). Acid & Metal Sulfide:
$2\ HNO_3(aq) + K_2S(aq) \rightarrow H_2S(g) + 2\ KNO_3(aq)$. e). Acid & Metal Sulfite: $2\ HF(aq) + CaSO_3(aq) \rightarrow CaF_2(aq) + H_2O(l) + SO_2(g)$.
7a). $2\ H^+(aq) + O^{2-}(aq) \rightarrow H_2O(l)$. b). $Zn(s) + 2\ H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$. c). $2\ H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g)$.
d). $2\ H^+(aq) + S^{2-}(aq) \rightarrow H_2S(g)$. e). $2\ H^+(aq) + SO_3^{2-}(aq) \rightarrow H_2O(l) + SO_2(g)$. 8a). Hydrochloric Acid. b). Sulfuric Acid. c). Acetic Acid. d). Sodium Hydroxide. e). Limewater. f). Ammonia. g). Hydrogen Sulfide. h). Water.

UNIT 2 **STOICHIOMETRY REVISION I QUESTIONS** **CHEMISTRY**

1. Use mol formula to fill in the following table:
Ar(Na) = 23, Ar(Cu) = 63.5, Ar(Ag) = 108, Ar(Cl) = 35.5, Ar(H) = 1, Ar(O) = 16, Ar(C) = 12, Ar(S) = 32, Ar(N) = 14.

Item	Amount in mol	Mass of Solute	Volume of Solution	Concentration of Solute
a).	1.00 mol of NaCl solute			0.100 M NaCl solution
b).		1.70 g of $AgNO_3$ solute		1.0 M $AgNO_3$ solution
c).			150 mL of NaOH solution	0.60 M NaOH solution
d).	0.020 mol of $CuSO_4$ solute		0.250 L of $CuSO_4$ solution	
e).		31.0 g of Na_2O solute	400 mL of Na_2O solution	
f).			1.20 L of NH_3 solution	0.20 M NH_3 solution

2. When solving stoichiometry questions:

Step 1. write a balanced equation (with states). *The coefficients give a whole number <u>mol</u> ratio of the reactants and products.*
eg. **2** Mg(s) + **1** O_2(g) ---> **2** MgO(s) means that we can have:
0.2 mol **0.1** mol **0.2** mol OR
0.1 mol **0.05** mol **0.1** mol OR
any other amounts in mol as long as they have the same ratios as the coefficients in the equation.

If the reaction equation is not properly balanced, the answers to the stoichiometry questions cannot be correctly determined.
Step 2. convert the measurements known about a chemical into mol using a mol formulae.

$n\ (solute) = \frac{Mass:\ m\ in\ g}{Molecular\ Mass:\ Mr}$, *n (solute in solution) = C (in M or mol/L) x V (in L),* $n\ (solute) = \frac{\text{No. of Particles}}{\text{Avogadros Const} : 6.0223 \times 10^{23}}$

$n\ (gas) = \frac{\text{Pressure: P in kPa x Volume: V in L}}{\text{Gas Const: R [8.31] x Temp: T in K}}$ or $\frac{\text{Volume : V in L}}{\text{Molar Volume, } V_m \text{ in Lmol}^{-1}}$ *where Vm = 22.4 L at S.T.P. (273K and 101.325 kPa).*

Step 3. then use the coefficients in the balanced equation to find the mol of the required chemical using:
n(What you want) = $\frac{\text{Coefficient of Chemical Wanted}}{\text{Coefficient of Chemical Known}}$ x n(Chemical Known)
Step 4. and then convert this mol into the required unit by rearranging a mol formula.

In the precipitation reaction: Silver Nitrate ($AgNO_3$) solution reacts with Copper Chloride ($CuCl_2$) solution, according to the reaction equation:

$$\boxed{2}\ AgNO_3(aq) + \boxed{1}\ CuCl_2(aq) \text{ ---> } \boxed{1}\ Cu(NO_3)_2(aq) + \boxed{2}\ AgCl(s).$$

Ar(Ag) = 108, Ar(N) = 14, Ar(O) = 16, Ar(Cu) = 63.5 and Ar(Cl) = 35.5

a). In a particular experiment, **2.0** mol of pure Silver Nitrate reacts. What amount of Copper Chloride (in mol) should react?
b). In another experiment, **0.20** mol of pure Silver Nitrate reacts. What amount of Copper Chloride (in mol) should react?
c). In another experiment, **0.30** mol of pure Silver Nitrate reacts. What amount of Copper Chloride (in mol) should react?
d). In another experiment, **0.40** mol of Copper Chloride reacts. What amount of Silver Chloride (in mol) should be produced?
e). In another experiment, **0.400** mol of Copper Chloride reacts. What mass of Silver Nitrate should react?
Hint: Find the amount in mol of Silver Nitrate and then rearrange $n = \frac{Mass:\ m\ in\ g}{Molecular\ Mass:\ Mr}$ to find the mass of Silver Nitrate.
f). In another experiment, **0.3000** mol of Silver Nitrate reacts. What mass of Copper Chloride should react?
g). In another experiment, **0.1000** mol of Silver Nitrate reacts. What mass of Silver Chloride should be produced?
h). In another experiment, **1.43 g** of Silver Chloride is produced. What amount (in mol) of Silver Nitrate should have reacted?
i). In another experiment, **1.0 L** of **0.20 M** Silver Nitrate reacts. What amount of Copper Chloride (in mol) should react?
Hint: Convert the Volume and Concentration into mol and then use the mol ratios to find n($CuCl_2$).
j). In another experiment, **100 mL** of **0.20 M** Copper Chloride reacts. What amount of Silver Nitrate (in mol) should react?
k). In another experiment, **200 mL** of **0.10 M** Copper Chloride reacts. What amount of Silver Chloride (in mol) should be produced?
l). In another experiment, **200 mL** of **0.10 M** Copper Chloride reacts. What mass of Silver Chloride should be produced?
m). In another experiment, **1.2×10^{22}** Copper Chloride molecules react. What amount of Silver Chloride (in mol) should be produced?
n). In another experiment, **3.00×10^{22}** Copper Chloride molecules react. What mass of Silver Chloride (in mol) should be produced?

ANSWERS: 1a). 58.5 g, 10 L. b). 0.010 mol, 10 mL. c). 0.090 mol, 3.6 g. d). 3.2 g, 0.080 M. e). 0.500 mol, 1.25 M. f). 0.24 mol, 4.1 g. 2a). 1.0 mol. b). 0.10 mol. c). 0.15 mol. d). 0.80 mol. e). 136 g. f). 20.17 g. g). 14.34 g. h). 0.0100 mol. i). 0.10 mol. j). 0.040 mol. k). 0.040 mol. l). 5.7 g. m). 0.04 mol. n). 14.3 g.

UNIT 2 **STOICHIOMETRY REVISION II QUESTIONS** **CHEMISTRY**

When solving stoichiometry questions remember the following steps:

Step 1. write a balanced equation (with states). *The coefficients give a whole number mol ratio of the reactants and products.*

Step 2. convert the measurements known about a chemical into mol using a mol formulae.

$n\ (solute) = \frac{Mass:\ m\ in\ g}{Molecular\ Mass:\ Mr}$, *n (solute in solution) = C (in M or mol/L) x V (in L),* $n\ (solute) = \frac{\text{No. of Particles}}{\text{Avogadros Const : } 6.0223 \times 10^{23}}$

Step 3. then use the coefficients in the balanced equation to find the mol of the required chemical using:

$n(What\ you\ want) = \frac{Coefficient\ of\ Chemical\ Wanted}{Coefficient\ of\ Chemical\ Known}\ x\ n(Chemical\ Known)$

Step 4. then convert this mol into the required unit by rearranging a mol formula.

1. In an experiment, 1.22 g of Magnesium reacts with Oxygen according to the equation (Ar(Mg) = 24.3, Ar(O) = 16):

$$\boxed{2}\ \mathbf{Mg(s)} + \boxed{1}\ \mathbf{O_2(g)} \rightarrow \boxed{2}\ \mathbf{MgO(s)}$$

a). Determine the amount (in mol) of Magnesium that reacted. *Hint: use* $n(Mg) = \frac{Mass:\ m\ in\ g}{Molecular\ Mass:\ Mr}$.

b). Use the equation coefficients and the amount of Magnesium to find the amount of Oxygen that reacted.

c). Determine the mass of Oxygen that reacted. *Hint: use* $m(O_2) = n(O_2)\ x\ Mr(O_2)$.

d). Determine the number of Oxygen atoms that reacted. *Hint: use* $Number(O) = n(O_2)\ x\ N_a\ x$ *number of O atoms in* O_2.

2. In a reaction, 200 mL of 0.40 M Sulfuric acid reacts according to the equation: (Ar(Na) = 23, Ar(O) = 16, Ar(H) = 1):

$$\boxed{1}\ \mathbf{H_2SO_4(aq)} + \boxed{2}\ \mathbf{NaOH(aq)} \rightarrow \boxed{1}\ \mathbf{Na_2SO_4(aq)} + \boxed{2}\ \mathbf{H_2O(l)}$$

a). Determine the amount (in mol) of Sulfuric acid that reacted. *Hint: use* $n(H_2SO_4) = c\ x\ V$*: remember V in L.*

b). Use the equation coefficients and the amount of Sulfuric acid to find the amount of Sodium Hydroxide that reacted.

c). Determine the mass of Sodium Hydroxide that reacted.

d). What volume of 0.20 M Sodium Hydroxide was required to completely react the Sulfuric acid. *Hint: use* $V = \frac{n(NaOH)}{[NaOH]}$

In this next question, since there are measurements for more than one chemical, one of them will be in EXCESS.

3. In an experiment, 6.8 g of Ammonia, NH_3 is placed in a flask with 19.2 g of Oxygen, O_2 and reacts according to the equation:

$$\boxed{4}\ \mathbf{NH_3(g)} + \boxed{5}\ \mathbf{O_2(g)} \rightarrow \boxed{4}\ \mathbf{NO(g)} + \boxed{6}\ \mathbf{H_2O(l)}$$

a). Determine the amount (in mol) of Ammonia and Oxygen (Ar(N) = 14, Ar(H) = 1, Ar(O) = 16).

b). If Ammonia and Oxygen should react in the ratio of 4:5 but the mol amounts are in the ratio .4:.6, which is in excess?

Hint: To clearly see which chemical is in excess (larger), divide each amount (from Q3a) by the coefficient in the equation..

c). Determine the mass of Nitrous Oxide, NO produced.

Hint: Use the amount of the Limiting Reactant (not in Excess) and the equation coefficients to find n(NO).

d). Determine the amount (in mol) of Oxygen in excess.

Hint: Follow the hint in Q3b and then subtract these values and multiply the result by the coefficient of the chemical in excess.

4. A precipitate of Silver can be prepared according to the reaction: $AgNO_3(aq) + NH_4Cl(aq) \rightarrow AgCl(s) + NH_4NO_3(aq)$

a). Determine the mass of AgCl precipitated using 200 mL of 0.200 M $AgNO_3$ solution (Ar(Ag) = 108, Ar(Cl) = 35.5).

b). If 0.200 mol of $AgNO_3$ and 0.300 mol of NH_4Cl is initially placed in the reaction chamber, determine the limiting reactant and therefore determine the amount and mass of Silver Chloride that will be produced.

In this next question, you will use the calculations from a Titration experiment. This is of a Year 12 question standard.

5. In an experiment, a 5.00 mL sample of Brick Cleaner containing HCl is placed in a 250 mL Volumetric flask and filled to the neck mark with water. A 20.00 mL aliquot of the diluted HCl is transferred to a conical flask using a pipette and 3 drops of an indicator are added. Slowly 0.100 M Na_2CO_3 from a burette is added to the HCl in the conical flask. After repeated titrations, the Average Titre volume of Na_2CO_3 was 18.15 mL HINT: Always start at the end of the question and work backwards.

a). Write a balanced equation for the reaction between HCl and Na_2CO_3.

b). Determine the amount (in mol) of Na_2CO_3 titrated using the concentration and Average Titre volume.

c). Use the equation coefficients and the amount of Na_2CO_3 to find the amount of HCl in the Conical flask that reacted.

d). Use the volume of the Volumetric flask and Conical flask & n(HCl) to determine the amount of HCl in the Volumetric flask.

e). Determine the concentration of HCl in the brick cleaner using the n(HCl) from Q5d and the volume of the sample.

ANSWERS: 1a). 0.502 mol. b). 0.251 mol. c). 8.03 g. d). 3.02×10^{23}. 2a). 0.080 mol. b). 0.16 mol. c). 6.4 g. d). 0.80 L. 3a). NH_3 = 0.40 mol, O_2 = 0.60 mol. b). O_2. c). 12 g. d). 1.0 mol. 5a). $2\ HCl(aq) + Na_2CO_3(aq) \rightarrow 2\ NaCl(aq) + CO_2(g) + H_2O(l)$. b). 1.82×10^{-3} mol. c). 3.63×10^{-3} mol. d). 0.0454 mol. e). 9.08 M. 4a). 5.74 g. b). 0.200 mol $AgNO_3$, 28.7 g.

UNIT 2 **REDOX THEORY REVISION I QUESTIONS** **CHEMISTRY**

Remember:
Oxidation (of the Reductant) involves e^- being produced (RHS) and the Oxidation Number increases while Reduction (of the oxidant) involves e^- reacting (on the LHS) and the Oxidation Number decreases
The Oxidation Number of an element is 0 and is the same as the charge on the ion but the sign is written first.

1. Determine the Oxidation Number of the following underlined species:

a). $\underline{O}_2$ b). $\underline{Na}$. c). $\underline{He}$. d). $\underline{S}_8$.

e). $\underline{H}_2O$. f). $Na\underline{Cl}$. g). $\underline{N}H_3$. h). $\underline{N}O_2$.

i). $Na_2\underline{C}O_3$. j). $\underline{Cu}CO_3$. k). $K\underline{Mn}O_4$. l). $Na_2\underline{Cr}_2O_7$.

2. Use Oxidation numbers to predict if the following unbalanced equations involve Oxidation or Reduction:

a). $Na^+ \rightarrow Na$. b). $I_2 \rightarrow I^-$. c). $Cu \rightarrow CuO$. d). $H_2 \rightarrow H^+$.

e). $N_2O \rightarrow NO$. f). $SO_3 \rightarrow SO_2$. g). $H_2O \rightarrow H_2O_2$. h). $H_2SO_4 \rightarrow SO_2$.

3. Balance the following equation by adding e^- to the correct side of the reaction arrow:

a). $Na \rightarrow Na^+$. b). $I_2 \rightarrow 2\ I^-$. c). $Cu^{2+} \rightarrow Cu$. d). $2\ Cl^- \rightarrow Cl_2$.

4. Determine the Overall equation by balancing the number of e^- on opposite sides of the reaction arrow and then add the partial equations together and cancel the e^-:

a). $Na(s) \rightarrow Na^+(aq) + e^-$
and $Ag^+(aq) + e^- \rightarrow Ag(s)$.

b). $F_2(g) + 2\ e^- \rightarrow 2\ F^-(aq)$
and $Cu(s) \rightarrow Cu^{2+}(aq) + 2\ e^-$.

c). $Zn(s) \rightarrow Zn^{2+}(aq) + 2\ e^-$
and $Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$.

d). $Pb(s) \rightarrow Pb^{2+}(aq) + 2\ e^-$
and $Cl_2(aq) + 2\ e^- \rightarrow 2\ Cl^-(aq)$.

e). $F_2(g) + 2\ e^- \rightarrow 2\ F^-(aq)$
and $Li(s) \rightarrow Li^+(aq) + e^-$.

f). $Fe(s) \rightarrow Fe^{2+}(aq) + 2\ e^-$
and $O_2(g) + 2\ H_2O(l) + 4\ e^- \rightarrow 4\ OH^-(aq)$.

5. Write the following as balanced equations:
a). Sodium metal reacts with Fluorine solution to form Sodium Fluoride.

b). Zinc metal is placed in Copper Chloride solution and Copper metal is produced in a solution of Zinc Chloride.

c). Ferrous (Iron II) Hydroxide is oxidised to Ferric (Iron III) Hydroxide in the presence of Oxygen and Water.

Answers: 1a). 0. b). 0. c). 0. d). 0. e). +1. f). -1. g). -3. h). +4. i). +4. j). +2. k). +7. l). +6. 2a). Reduction. b). Reduction. c). Oxidation. d). Oxidation. e). Oxidation. f). Reduction. g). Oxidation. h). Reduction. 3a). a). $Na \rightarrow Na^+ + e^-$. b). $I_2 + 2\ e^- \rightarrow 2\ I^-$. c). $Cu^{2+} + 2\ e^- \rightarrow Cu$. d). $2\ Cl^- \rightarrow Cl_2 + 2e^-$. 4a). $Na(s) + Ag^+(aq) \rightarrow Na^+(aq) + Ag(s)$. b). $Cu(s) + F_2(g) \rightarrow Cu^{2+}(aq) + 2\ F^-(aq)$ (or $CuF_2(aq)$). c). $Zn(s) + 2\ Fe^{3+}(aq) \rightarrow Zn^{2+}(aq) + 2\ Fe^{2+}(aq)$. d). $Pb(s) + Cl_2(aq) \rightarrow Pb^{2+}(aq) + 2\ Cl^-(aq)$ (or $PbCl_2(aq)$). e). $F_2(g) + 2\ Li(s) \rightarrow 2\ Li^+(aq) + 2\ F^-(aq)$ (or 2 LiF). f). $2\ Fe(s) + O_2(g) + 2\ H_2O(l) \rightarrow 2\ Fe^{2+}(aq) + 4\ OH^-(aq)$ (or 2 $Fe(OH)_2(s)$). 5a). $2\ Na(s) + F_2(aq) \rightarrow 2\ NaF(aq)$. b). $Zn(s) + CuCl_2(aq) \rightarrow ZnCl_2(aq) + Cu(s)$. c). $4\ Fe(OH)_2(s) + O_2(g) + 2\ H_2O(l) \rightarrow 4\ Fe(OH)_3(s)$.

UNIT 2 **REDOX THEORY REVISION II QUESTIONS** **CHEMISTRY**

Remember: The Higher Reduction (on the LHS of the Series) will react with the Lower Oxidation (on the RHS of the Series). Reduction occurs at the Cathode (+) and Oxidation occurs at the anode (-).

Strongest Oxidant (PREFER REDUCTION ->)

$Au^{3+}(aq) + 3\ e^- \Leftrightarrow Au(s)$.
$Ag^+(aq) + e^- \Leftrightarrow Ag(s)$.
$Cu^{2+}(aq) + 2\ e^- \Leftrightarrow Cu(s)$.
$Pb^{2+}(aq) + 2\ e^- \Leftrightarrow Pb(s)$.
$Sn^{2+}(aq) + 2\ e^- \Leftrightarrow Sn(s)$.
$Ni^{2+}(aq) + 2\ e^- \Leftrightarrow Ni(s)$.
$Fe^{2+}(aq) + 2\ e^- \Leftrightarrow Fe(s)$.
$Zn^{2+}(aq) + 2\ e^- \Leftrightarrow Zn(s)$.
$Al^{3+}(aq) + 3\ e^- \Leftrightarrow Al(s)$.
$Mg^{2+}(aq) + 2\ e^- \Leftrightarrow Mg(s)$.
$Na^+(aq) + e^- \Leftrightarrow Na(s)$.
$Ca^{2+}(aq) + 2\ e^- \Leftrightarrow Ca(s)$.
$K^+(aq) + e^- \Leftrightarrow K(s)$.
$Li^+(aq) + e^- \Leftrightarrow Li(s)$.

Weakest Reductant

Weakest Oxidant

(PREFER OXIDATION <--) Strongest Reductant

1. Using the Electrochemical Series listed above, identify the:
a). strongest oxidant. b). weakest oxidant. c). strongest reductant. d). weakest reductant.

2. Answer True or False to each of the following:
a). Al(s) can act as an oxidant. b). $Al^{3+}(aq)$ can act as an oxidant.
c). Fe(s) is a stronger reductant than Ag(s). d). Fe(s) is more reactive than Ag(s).
e). $Sn^{2+}(aq)$ is a stronger oxidant than $Zn^{2+}(aq)$. f). The reductant reduces the other reactant.
g). The oxidant oxidises the other reactant and it will be reduced. h). $Ni^{2+}(aq)$ will be reduced in the presence of Zn(s).
i). K(s) will be reduced in the presence of $Mg^{2+}(aq)$. j). Zn(s) will be oxidised in the presence of $Pb^{2+}(aq)$.

3. Using the Electrochemical Series listed above, choose 2 species that are a:
a). stronger oxidant than $Al^{3+}(aq)$. b). weaker reductant than Ni(s).
c). weaker oxidant than $Zn^{2+}(aq)$. d). stronger reductant than Mg(s).

4. Using the Electrochemical Series listed above, choose 2 species that would:
a). oxidise Fe(s) to $Fe^{2+}(aq)$. b). reduce $Pb^{2+}(aq)$ to Pb(s). c). oxidise Cu(s) to $Cu^{2+}(aq)$. d). reduce $Ni^{2+}(aq)$ to Ni(s).

5. a). Explain the 2 functions of the **SALT BRIDGE** in a Galvanic cell.
b). At which electrode does **REDUCTION** occur?
c). At which electrode does **OXIDATION** occur?
d). If the amount of positive charge at the Anode is increasing, what **IONS** flow out of the Salt Bridge to balance the charge?
e). If the amount of positive charge at the Cathode is decreasing, what **IONS** flow out of the Salt Bridge to balance the charge?
f). Explain why a reaction between Cu(s) in one half cell containing non copper ions connected to another half cell containing $Zn^{2+}(aq)$ with an unreactive electrode would not occur.

6. Draw an Electrochemical Cell containing a half cell with a Copper electrode immersed in a $Cu(NO_3)_2(aq)$ electrolyte and another half cell containing a Zinc electrode immersed in a $Zn(NO_3)_2(aq)$ electrolyte.
a). Using the Electrochemical Series listed above, predict the identity of the (i). Anode. (ii). Cathode.
b). Determine the direction of the flow of electrons.
c). Determine the identity of the products at the anode and cathode.
d). Write balanced half cell equations for the reactions occurring at the anode and cathode.
e). Write a balanced overall cell equation.

7. Determine if you would expect a reaction to occur and if so, write balanced half cell and an overall equation.
a). In a half cell with a Silver Electrode and $AgNO_3$ solution and another half cell with a Zinc electrode and $Zn(NO_3)_2$ solution.
b). In a half cell with a Silver Electrode and $AgNO_3$ solution and another half cell with a Carbon electrode and $Cu(NO_3)_2$ sol'n.

ANSWERS: 1a). $Au^{3+}(aq)$. b). $Li^+(aq)$. c). Li(s). d). Au(s). 2a). F. b). T. c). T. d). T. e). T. f). T. g). T. h). T. i). F. j). T.
3a). any metal cation (LHS) above $Al^{3+}(aq)$. b). any metal (RHS) above Ni(s). c). any metal cation (LHS) below $Zn^{2+}(aq)$. d). any metal (RHS) below Mg(s). 4a). any metal cation (LHS) above $Fe^{2+}(aq)$. b). any metal (RHS) below Pb(s). c). any metal cation (LHS) above $Cu^{2+}(aq)$. d). any metal (RHS) below Ni(s). 5a). Complete the circuit and allow ions to flow to each half cell to balance charges produced. b). Cathode. c). Anode. d). Anions. e). Cations. f). Copper is a weak reductant and $Zn^{2+}(aq)$ is a weak oxidant. 6a). (i). Zn. (ii). Cu. b). From Zn to Cu. c). Anode = $Zn^{2+}(aq)$, Cathode = Cu(s).
d). Anode = Zn(s) --> $Zn^{2+}(aq) + 2\ e^-$, Cathode = $Cu^{2+}(aq) + 2\ e^-$ --> Cu(s). e). $Zn(s) + Cu^{2+}(aq)$ --> $Cu(s) + Zn^{2+}(aq)$.
7a). Anode: Zn(s) --> $Zn^{2+}(aq) + 2\ e^-$, Cathode: $Ag^+(aq) + e^-$ --> Ag(s). Overall: $Zn(s) + 2\ Ag^+(aq)$ --> $2\ Ag(s) + Zn^{2+}(aq)$. b). No Reaction.

UNIT 2 **REDOX THEORY REVISION III QUESTIONS** **CHEMISTRY**

1. During a redox reaction the oxidant undergoes:
A. oxidation. B. combustion. C. reduction. D. polymerisation.

2. The movement of electrons in a redox reaction is from the electrode where:
A. oxidation occurs to the electrode where reduction occurs. B. oxidation occurs to the salt bridge.
C. reduction occurs to the salt bridge. D. reduction occurs to the electrode where oxidation occurs.

3. Which of the following is true about the corrosion of iron:
A. the iron is oxidised from Fe to Fe^{2+} then to Fe^{4+}. B. the iron is oxidised from Fe to Fe^{1+} then to Fe^{2+}.
C. the iron is oxidised from Fe to Fe^{2+} then to Fe^{3+}. D. water and oxygen is oxidised in the corrosion process.

4. Which of the following processes will **not** prevent corrosion of a surface:
A. connecting the surface to the cathode. B. painting the surface with non reactive chemicals.
C. applying a more reactive metal to the surface. D. connecting the surface to a non reactive metal.

5. The formula for the oxide of Iron that is called rust is:
A. FeO(s). B. Fe(s). C. $Fe_2O_3.xH_2O(s)$. D. $Fe(OH)_3(s)$.

6. The purpose of the electrodes in a galvanic cell is to:
A. provide a material which can never react during a reaction.
B. provide a material for ions or the metal electrode to react with the salt bridge.
C. provide a material for ions or the metal electrode to react with electrons in the external circuit.
D. connect together the half cells so ions can move between them to balance any excess charges produced.

7. The process that occurs at the anode in a galvanic cell is:
A. reduction. B. oxidation. C. acid/base reaction. D. respiration.

8. Metals like Lithium and Sodium cannot be used to protect other metals from oxidation because these metals:
A. are not reactive. B. prefer to undergo reduction.
C. react violently in water producing strong bases. D. will not undergo sacrificial oxidation.

9. The amount in mol of copper produced when 0.6 mol of Aluminium is oxidised in the reaction:
$3\ CuCl_2(aq) + 2\ Al(s) \rightarrow 3\ Cu(s) + 2\ AlCl_3(aq)$ is:
A. 0.9 mol. B. 0.6 mol. C. 0.4 mol. D. 1.2 mol.

10. The salt bridge is usually impregnated with KNO_3 because this chemical:
A. does not interfere with the reactions occurring at the anode and cathode.
B. initiates the chemical reactions that occur at the anode and cathode.
C. causes oxidation reactions to occur at the cathode and reductions reactions to occur at the anode.
D. is not a conductive material.

11. Draw a diagram of a galvanic cell showing the anode, cathode, salt bridge and flow of electrons and the flow of anions and cations in the Internal Circuit.

12. Explain the terms: a). Oxidant. b). Reductant. c). Oxidation. d). Reduction. e). Internal Circuit.

13. List the order of metal reactivity and use it to determine if zinc will be oxidised in the presence of: a). Na^+. b). Cu^{2+}.

14. Use the reaction: $Cu^{2+}(aq) + Zn(s) \rightarrow Cu(s) + Zn^{2+}(aq)$ to determine the mass of Copper produced when 2.0 g of Zinc reacts. $A_r(Cu) = 63.5$, $A_r(Zn) = 65.4$.

15. Use the reaction: $2\ Fe(s) + O_2(g) + H_2O(l) \rightarrow 2\ Fe(OH)_2(s)$ to determine the mass of Iron Hydroxide produced when 10.0 L of Oxygen gas reacts at 101.3 kPa and 0 °C. ($A_r(Fe) = 56$, $A_r(O) = 16$, $A_r(H) = 1$).

16. Explain why a copper container will start to oxidise if filled with a solution of Silver Nitrate while it will not oxidise if filled with a solution of Aluminium Nitrate.

Multiple Choice Answers: 1. C. 2. A. 3. C. 4. D. 5. C. 6. C. 7. B. 8. C. 9. A. 10. A.
13. Au, Pt, C, Ag, Cu, Pb, Sn, Ni, Fe, Mn, Cr, Zn, Al, Mg, Na, Ca, K, Li. a). No. b). Yes. 14. 1.94 g. 15. 80.4 g.
16. Since the Silver ions are an oxidant higher on the Activity Series than the reductant Copper, the Copper will react and be oxidised but not by Aluminium ions which are below Copper.

UNIT 2 **REDOX THEORY REVISION IV QUESTIONS** **CHEMISTRY**

Remember: The Higher Reduction (on the LHS of the Series) will occur with the Lower Oxidation (on the RHS of the Series) and Reduction occurs at the Cathode (+) and Oxidation occurs at the anode (-).

Strongest Oxidant (PREFER REDUCTION ->) ↑

$Au^{3+}(aq) + 3\ e^- \Leftrightarrow Au(s)$.
$Ag^+(aq) + e^- \Leftrightarrow Ag(s)$.
$Cu^{2+}(aq) + 2\ e^- \Leftrightarrow Cu(s)$.
$Pb^{2+}(aq) + 2\ e^- \Leftrightarrow Pb(s)$.
$Sn^{2+}(aq) + 2\ e^- \Leftrightarrow Sn(s)$.
$Fe^{2+}(aq) + 2\ e^- \Leftrightarrow Fe(s)$.
$Zn^{2+}(aq) + 2\ e^- \Leftrightarrow Zn(s)$.
$Mg^{2+}(aq) + 2\ e^- \Leftrightarrow Mg(s)$.
$Na^+(aq) + e^- \Leftrightarrow Na(s)$.
$Ca^{2+}(aq) + 2\ e^- \Leftrightarrow Ca(s)$.
$K^+(aq) + e^- \Leftrightarrow K(s)$.
$Li^+(aq) + e^- \Leftrightarrow Li(s)$.

Weakest Reductant ↓

Weakest Oxidant

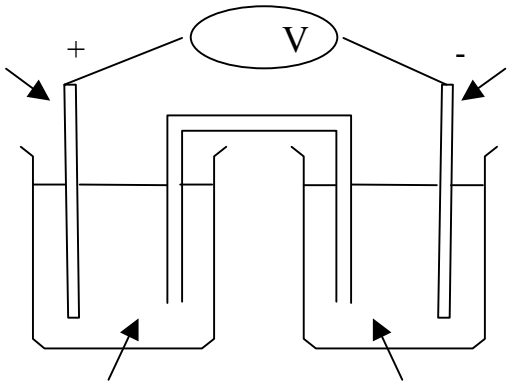
(PREFER OXIDATION <--) Strongest Reductant

1. In the Electrochemical cell below is a Half cell containing a Lead (Pb) strip immersed in $Pb(NO_3)_2$ solution and in the other Half cell is a Copper strip (Cu) immersed in $Cu(NO_3)_2$ solution.

a). Label the Cathode (+), Anode (-) and the Electrolytes in each Half Cell.

b). Provide the Half Cell equation for the reaction that occurs at the Cathode.

c). Provide the Half Cell equation for the reaction that occurs at the Anode.

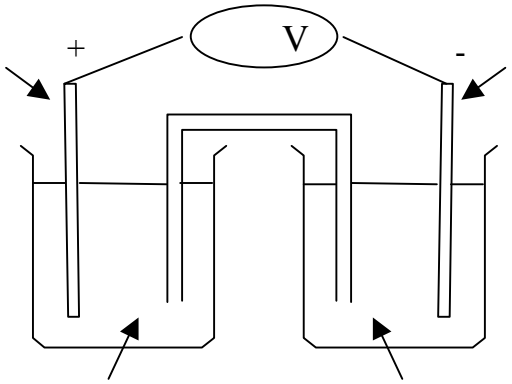


2. In the Electrochemical cell below is a Half cell containing a Silver (Ag) strip immersed in $AgNO_3$ solution and in the other Half cell is an Iron strip (Fe) immersed in $Fe(NO_3)_2$ solution.

a). Label the Cathode (+), Anode (-) and the Electrolytes in each Half Cell.

b). Provide the Half Cell equation for the reaction that occurs at the Cathode.

c). Provide the Half Cell equation for the reaction that occurs at the Anode.

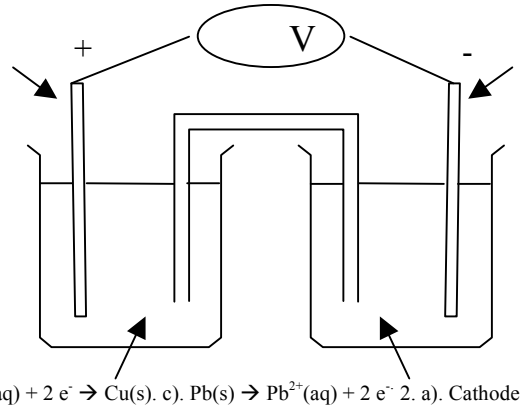


3. In the Electrochemical cell below is a Half cell containing a Zinc (Zn) strip immersed in $Zn(NO_3)_2$ solution and in the other Half cell is an Iron strip (Fe) immersed in $Fe(NO_3)_2$ solution.

a). Label the Cathode (+), Anode (-) and the Electrolytes in each Half Cell.

b). Provide the Half Cell equation for the reaction that occurs at the Cathode.

c). Provide the Half Cell equation for the reaction that occurs at the Anode.



Answers: 1. a). Cathode = Cu, Anode = Pb, Electrolytes = $Cu(NO_3)_2$, $Pb(NO_3)_2$. b). $Cu^{2+}(aq) + 2\ e^- \rightarrow Cu(s)$. c). $Pb(s) \rightarrow Pb^{2+}(aq) + 2\ e^-$ 2. a). Cathode = Ag, Anode = Fe, Electrolytes = $AgNO_3$, $Fe(NO_3)_2$. b). $Ag^+(aq) + e^- \rightarrow Ag(s)$. c). $Fe(s) \rightarrow Fe^{2+}(aq) + 2\ e^-$ 3. a). Cathode = Fe, Anode = Zn, Electrolytes = $Fe(NO_3)_2$, $Zn(NO_3)_2$. b). $Fe^{2+}(aq) + 2\ e^- \rightarrow Fe(s)$. c). $Zn(s) \rightarrow Zn^{2+}(aq) + 2\ e^-$

UNIT 2 **GAS THEORY REVISION I QUESTIONS** **CHEMISTRY**

Formula: $P V = n R T$. $n = \frac{V}{Vm}$. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ where P is in kPa, V is in L, n is in mol, T is in K ($^oC + 273$), R = 8.314.

1. Which of the following gases is a reactant in the process of Photosynthesis:
A. CO_2. B. O_2. C. CO. D. N_2.

2. Oxides of Nitrogen are dangerous to the environment because they:
A. form bases when dissolved in atmospheric moisture. B. form acids when dissolved in atmospheric moisture.
C. form chemicals that break down building materials. D. form chemicals that break down the ozone layer.

3. Which of the following reactions types does **not** produce Carbon Dioxide:
A. Fermentation. B. Respiration. C. Combustion of fuels. D. Photosynthesis.

4. Boyle's Law states that the pressure of a gas can be increased by:
A. increasing the amount of gas present. B. reducing the volume of the container.
C. increasing the temperature. D. adding other gases to the container.

5. Charle's Law states that the volume of a gas can be increased by:
A. increasing the amount of gas present. B. increasing the pressure of the container.
C. increasing the temperature. D. adding other gases to the container.

6. The volume of Nitrous oxide, NO produced in the reaction $N_2(g) + O_2(g) \rightarrow 2\ NO(g)$ if 10 L of $N_2(g)$ and 10 L of $O_2(g)$ is reacted at 25 ºC and a pressure of 200 kPa will be:
A. 5 L. B. 10 L. C. 20 L. D. 40 L.

7. The molar volume, V_m is equal to the volume:
A. occupied by all the gases at 25 ºC and 101.325 kPa. B. occupied by one mole of any gas.
C. required to react with one mole of each reactant. D. required to have 1.0 M concentration of each gas.

8. The amount of gas present in a 1.5 L container at 100 kPa and 20 ºC is:
A. not determinable. B. 7.5 mol. C. 0.51 mol. D. 0.06 mol.

9. As the temperature of a gas increases at constant pressure, the molecules:
A. move slower. B. stop moving. C. do nothing. D. move quicker.

10. When a 2.0 L flask at 100 kPa is connected to a 3.00 L flask at 50 kPa both at the same temperature, the overall pressure in the 5.00 L container is:
A. 75.0 kPa. B. 100 kPa. C. 70.0 kPa. D. 85.0 kPa.

11. Define the term **Greenhouse Effect** and use it to explain how **Green Technology** is attempting to reduce its effect.

12. Explain the purpose of the Kyoto Protocol.

13. Explain the difference between Nitrogen Fixation and Dentrification.

14. Determine what happens to pressure if:
a). the volume decreases. b). the temperature rises. c). more of the gas is added.

15. Determine the volume occupied by a gas in a flask:
a). containing 0.20 mol of HCl at 300 kPa, 25 ºC. b). containing 0.30 mol of NH_3 at STP.
c). containing 1.20 mol of H_2 at SLC. d). containing 2.00 g of N_2 at 100 kPa and 20 ºC.

16. Determine the new pressure when a 2.0 L flask at 101 kPa is connected to a 1.0 L flask at 202 kPa (Total volume = 3.0 L) assuming the temperature stays constant.

17. Determine the volume of SO_3 produced when 20.0 L of $SO_2(g)$ reacts with 10.0 L of $O_2(g)$ according to the reaction:
$2\ SO_2(g) + O_2(g) \rightarrow 2\ SO_3(g)$ at 101.3 kPa and 25 ºC.

18. Determine the mass of NH_3 produced at 200.0 kPa and 120 ºC when 15.00 L of H_2 reacts according to the reaction:
$3\ H_2(g) + N_2(g) \rightarrow 2\ NH_3(g)$. $A_r(N) = 14$, $A_r(H) = 1$.

19. Fill in the following table:

Item	Amount in Mol	Pressure	Volume	Temperature
a).	0.100 mol of NO_2	105 kPa		120 ºC
b).		120 kPa	2.50 L	-20.00 ºC

Answers: 1. A. 2. B. 3. D. 4. B. 5. C. 6. C. 7. B. 8. D. 9. D. 10. C.. 11. Greenhouse Effect is atmospheric warming due to absorption of heat by gases such as CO_2 & CH_4. Green Technology attempts to replace the current chemicals that harm the environment with chemicals that have less effect. 12. The Kyoto Protocol wants participating countries to reduce the level of CO_2 emission by 29% at 2010 levels. 13. Nitrogen Fixation converts unreactive N_2 gas into another N species that can react while Denitrification converts this reactive species back to N_2. 14a). rises. b). rises. c). rises. 15a). 1.65 L. b). 6.72 L c). 29.4 L. d). 1.74 L. 16. 134.67 kPa. 17. 20 L. 18. 10.41 g 19a). 3.11 L b). 0.143 mol.

UNIT 2 **GAS THEORY REVISION II QUESTIONS** **CHEMISTRY**

Formula: P V = n R T. $n = \frac{V}{Vm}$. $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ where P is in kPa, V is in L, n is in mol, T is in K ($^oC + 273$), R = 8.314.

1. Write balanced chemical equations to illustrate each of the following reactions:
a). Respiration.
b). Anaerobic Respiration.
c). Photosynthesis.
d). Decomposition of Calcium Carbonate.

2. Explain 2 ways to detect the presence of Carbon Dioxide.

3. a). Which law states that at constant temperature, if the volume of the gas system is reduced, the pressure will increase?
b). Which law states that at constant pressure, if the temperature of the gas system is increased, the volume the gas occupies will increase?
c). What term is used for the volume occupied by 1.0 mol of any gas at a specific temperature and pressure.
d). Use the Kinetic Theory of Gases to explain why gases expand when heated.

4. Convert each of the following measurements into the units stated:

mmHg ⇄ (÷ 760 / X 760) **Atmosphere** ⇄ (X 101325 / ÷ 101325) **Pascal (Pa)** ⇄ (÷ 1000 / X 1000) **kPa** ⇄ (÷ 100 / X 100) **Bar** ⇄ (X 13.817 / ÷ 13.817) **PSI**

a). 1520 mmHg into kPa.
b). 760 mmHg into atm.
c). 202.65 kPa into atm.
d). 202650 Pa into mmHg.
e). 23 ºC into K.
f). –100 ºC into K.
g). 398 K into ºC.
h). 25 mL into L.

5. a). Determine the new pressure when the gas in a 5.0 L flask at 101 kPa is fed into a 3.0 L flask assuming the temperature stays constant.
b). Determine the volume of a flask needed to hold a gas at 2 atm which has been fed in from a 5.0 L flask at 101 kPa assuming the temperature stays constant. (Hint: you will need to convert the pressure in atm into kPa or vice versa).
c). Determine the new pressure when a 3.0 L flask at 101 kPa is connected to a 2.0 L flask at 202 kPa (Total volume = 5.0 L) assuming the temperature stays constant. (Hint: You will need to use $P_1V_1 + P_2V_2 = P_3V_3$).
d). Determine the new pressure when a gas in a 2.0 L flask at 0 ºC and 101 kPa is fed into a 5.0 L flask at 25 ºC.
e). Determine the volume of a flask needed to hold a gas at 200 kPa and 25 ºC which has been fed in from a 2.0 L flask at 278 K and 60 kPa.
f). Determine the new pressure when a 2.0 L flask at 50 ºC and 200 kPa is connected to a 3.0 L flask at 50 ºC and 125 kPa.
g). Determine the amount of gas present in a 3.0 L flask at SLC.
h). Determine the amount of gas present in a 2.5 L flask at STP.
i). What volume would 0.25 mol of O_2 gas occupy at SLC?
j). Determine the amount of N_2 gas present in a 5.0 L flask at 30 ºC and 200 kPa.
k). Determine the pressure of a gas in a 2.5 L flask at 200 ºC containing 0.050 mol of H_2.

6. Use the following equation to answer the questions below: $Cu(s) + 4\ HNO_3(aq) \rightarrow Cu(NO_3)_2(aq) + 2\ NO_2(g) + 2\ H_2O(l)$.
a). What volume of NO_2 gas will be produced if 6.35 g of Copper reacts at STP (0 ºC and 101.3 kPa) (Ar(Cu) = 63.5)?
b). What mass of Copper will need to react to produce 24.5 L of NO_2 gas at SLC (25 ºC and 101.3 kPa)?
c). Determine the volume of 2.0 M Nitric acid (HNO_3) required to produce 2.0 L of NO_2 gas at 25 ºC and 200 kPa.

7. Use the following equation to answer the questions below: $N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$.
a). What volume of NH_3 will produced at 25 ºC and 101.3 kPa if 20 L of N_2 reacts with 60 L of H_2?
b). What volume of N_2 will react at 0 ºC and 101.3 kPa to produce 20 L of NH_3?
c). What volume of H_2 will react at 300 K and 200 kPa to produce 50 L of NH_3?

Answers: a). $C_6H_{12}O_6(aq) + 6\ O_2 \rightarrow 6\ CO_2(g) + 6\ H_2O(l)$. b). $C_6H_{12}O_6(aq) \rightarrow 2\ C_2H_5OH(aq) + 2\ CO_2(g)$. c). $6\ CO_2(g) + 6\ H_2O(l) \rightarrow C_6H_{12}O_6(aq) + 6\ O_2$. d). $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$. 2. A lit splint will go out and when blown through Limewater, the $Ca(OH)_2$ will turn milky due to the formation of a precipitate of $CaCO_3$. 3. a). Boyle's Law. b). Charle's Law. c). Molar volume. c). As the gas molecules absorb energy, they move around at greater speeds and further distances causing them to occupy a larger volume. 4. a). 202.65 kPa. b). 1 atm. c). 2 atm. d). 1520 mmHg. e). 296 K. f). 173 K. g). 125 ºC. h). 0.025 L. 5. a). 168.3 kPa. b). 2.5 L. c). 141.4 kPa. d). 44.1 kPa. e). 0.64 L. f). 155 kPa. g). 0.122 mol. h). 0.112 mol. i). 6.13 L. j). 0.40 mol. k). 78.7 kPa. 6. a). 4.48 L. b). 31.8 g. c). 0.161 L or 161 mL. 7. a). 40 L. b). 10 L. c). 75 L.

UNIT 2 CHEMISTRY EXAM REVISION

Tips for Revising: Read through your notes, prepare summaries of the notes and give explanations of calculation steps.
Re do topic tests and do as many practice questions as possible.
Learn the Table of ions, the Solubility Table and the mole formulae:

$n = CV$, $n = \frac{m}{Mr}$, $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$, $PV = nRT$, $[H^+] \times [OH^-] = 1 \times 10^{-14}\ M^2$, $pH = -\text{Log}_{10}[H^+]$

Learn the definitions of Acids/Bases, Amphiprotic substances, pH, the Mole, Oxidant, Reductant, Oxidation, Reduction, Respiration, Kinetic Molecular Theory, Electrochemical/Galvanic Cells etc.

Tips for the Exam: Read through the instructions carefully and read through each question carefully.
Determine the time allocated for each question part and stick to it.
Attempt EVERY question
In Section A: Cross off any obviously wrong answer and do simple questions first.
In Section B: Answer the questions fully - provide detailed explanations.
Include states when writing equations and remember that ionic equations exclude Spectator ions.
Use the correct number of significant figures in numerical answers.

SECTION A: MULTIPLE CHOICE QUESTIONS:

1. Metal M forms a compound with the formula MSO_4. Which one of the following is the correct formula for another compound of metal M?
A. MCl. B. MOH. C. MCO_3. D. MNO_3.

2. Which of the following is **not** a method by which a solute can dissolve in water:
A. Dissociation. B. Ionisation. C. Forming Ion-Dipole bonds. D. Sublimation.

3. Which of the following is **not** an important function of water:
A. Keeping coffee warm. B. Dissolving polar solutes. C. Reacting in Photosynthesis. D. Energy source.

4. Which of the following molecules are **not** soluble in water:
A. LiCl. B. CH_3OH. C. C_4H_{10}. D. HCl.

5. The Ionic Equation for the Molecular Equation: $CaCO_3(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$ is:
A. $CaO(s) + 2\ H^+(aq) \rightarrow Ca^{2+}(aq) + H_2O(l)$. B. $CaCO_3(s) + 2\ H^+(aq) \rightarrow Ca^{2+}(aq) + H_2O(l) + CO_2(g)$.
C. $CaCO_3(s) + 2\ HCl(aq) \rightarrow CaCl_2(aq) + CO_2(g) + H_2O(l)$. D. $CO_3^{2-}(s) + 2\ HCl(aq) \rightarrow 2\ Cl^-(aq) + CO_2(g) + H_2O(l)$.

6. A saturated solution of KNO_3 is heated and **more** solid KNO_3 is added. The resultant solution is then slowly cooled without crystallisation occurring. You would expect the resultant solution to be:
A. Concentrated. B. Dilute. C. Still Saturated. D. Supersaturated.

7. The concentration in %w/v of a solution containing 24 g of NaCl in 200 mL of solvent would be:
A. 24 % w/v. B. 12 % w/v. C. 48 % w/v. D. 0.081 % w/v.

8. A solution containing 0.020 g/L NaCl would have the equivalent concentration of:
A. 200 ppb. B. 200 ppm. C. 20 ppm. D. 20 ppb.

9. Which one of the following is NOT a characteristic of acids?
A. neutralise solutions of NaOH. B. react with metals to form Hydrogen gas.
C. turn litmus paper pink. D. have a pH > 7.

10. The Conjugate Base of the $H_2PO_3^-$ ion is:
A. H_3PO_3. B. $H_2PO_4^-$. C. HPO_3^{2-}. D. PO_3^{3-}.

11. The substance which can readily function as an Amphiprotic species in an aqueous solution is:
A. H_3O^+. B. OH^-. C. CH_3COOH. D. HCO_3^-.

12. A strong acid is one which:
A. is pure. B. has a high pH.
C. produces many H_3O^+ ions in solution. D. has a concentration of at least 1.0 M.

13. The pH of a 0.001 M Hydrochloric acid solution would be:
A. 1. B. 2. C. 3. D. 4.

14. The pH of a 0.001 M NaOH solution would be:
A. 10^{-3}. B. -3. C. 3. D. 11.

15. When acetic acid, CH_3COOH is dissolved in water, only a small proportion of acetic acid molecules become ionised. Acetic acid can consequently be classified as:
A. a dilute acid. B. a concentrated acid. C. a strong acid. D. a weak acid.

16. In which of the following equations does the FIRST named reactant function as an acid?
A. $H_2O(l) + HCl(aq) \rightarrow H_3O^+(aq) + Cl^-(aq)$.
B. $NH_3(aq) + H_3O^+(aq) \rightarrow NH_4^+(aq) + H_2O(l)$.
C. $HCO_3^-(aq) + H_2O(l) \rightarrow CO_3^{2-}(aq) + H_3O^+(aq)$.
D. $S^{2-}(aq) + H_3O^+(aq) \rightarrow HS^-(aq) + H_2O(l)$.

17. A strip of Magnesium dissolves more quickly in 20 mL of 0.10 M Nitric acid than in 20 mL of 0.10 M Acetic acid because:
A. Nitric acid is a stronger acid than Acetic acid.
B. the Nitric acid is more concentrated than Acetic acid.
C. the Nitric acid is stronger and more concentrated.
D. the Magnesium - Acetic acid reaction is reversible.

18. Some pure solid Na_2CO_3 is dissolved in distilled water. A student discovers the resulting solution turns red litmus paper blue. The equation that best describes the equation occurring when Na_2CO_3 is added to water is:
A. $2\ Na(s) + 2\ H_2O(l) \rightarrow 2\ NaOH(aq) + H_2(g)$.
B. $HCO_3^-(aq) + H_2O(l) \rightarrow H_2CO_3(aq) + OH^-(aq)$.
C. $HCO_3^-(aq) + H_2O(l) \rightarrow H_3O^+(aq) + CO_3^{2-}(aq)$.
D. $CO_3^{2-}(aq) + H_2O(l) \rightarrow HCO_3^-(aq) + OH^-(aq)$.

19. In the reaction equation: $HCO_3^-(aq) + H_2O(l) \rightarrow CO_3^{2-}(aq) + H_3O^+(aq)$, the $HCO_3^-(aq)$ ion is acting as:
A. an oxidant. B. a reductant. C. an acid. D. a base.

20. The Molarity of a solution containing one gram of NaOH in 600 mL of water is: (Ar(Na) = 23, Ar(H) = 1, Ar(O) = 16)
A. 0.025 M. B. 0.0417 M. C. 16.6 M. D. 0.06 M.

21. In 0.50 L of a 2.0 M $CuCl_2$ solution, the concentration of the $Cl^-(aq)$ ion is:
A. 2.0 M. B. 4.0 M. C. 1.0 M. D. 0.50 M.

22. In the reaction: $Mg(s) + S(s) \rightarrow MgS(s)$:
A. Mg is oxidised and loses electrons.
B. Mg is reduced and gains electrons.
C. S is oxidised and gains electrons.
D. S is reduced and loses electrons.

23. In the reaction: $Zn(s) + 2\ H^+(aq) \rightarrow Zn^{2+}(aq) + H_2(g)$:
A. Zn is reduced. B. H^+ ions are oxidised. C. Zn is oxidised. D. H^+ ions are the reductant.

24. Consider the following equation: $2\ Cl^-(aq) \rightarrow Cl_2(aq) + 2\ e^-$. This reaction represents:
A. an acid-base reaction. B. a precipitation reaction. C. a reduction reaction. D. an oxidation reaction.

25. A solution is found to be a conductor of electricity. This indicates the solution most likely contains:
A. molecules. B. electrons. C. ions. D. atoms.

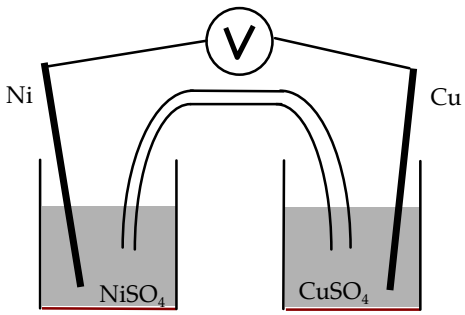
26. In which of the following equations is the first named reactant acting as a reductant (reducing agent or reducer):
A. $I_2(aq) + 2\ Na(s) \rightarrow 2\ NaI(s)$.
B. $2\ Br^-(aq) + Cl_2(g) \rightarrow Br_2(aq) + 2\ Cl^-(aq)$.
C. $2\ H^+(aq) + Mg(s) \rightarrow Mg^{2+}(aq) + H_2(g)$.
D. $Cl^-(aq) + AgNO_3(aq) \rightarrow AgCl(s) + NO_3^-(aq)$.

27. Which metal listed below is NOT likely to react when added to dilute Hydrochloric acid:
A. copper. B. iron. C. zinc. D. magnesium.

28. Tin metal reacts with $CuSO_4$ solution producing copper metal. Cadmium metal reacts with $SnCl_2$ solution producing tin metal. Which one of the following would you expect to occur to a significant extent:
A. $Sn^{2+}(aq) + Cu(s) \rightarrow Sn(s) + Cu^{2+}(aq)$.
B. $Cd^{2+}(aq) + Cu(s) \rightarrow Cd(s) + Cu^{2+}(aq)$.
C. $Cd^{2+}(aq) + Sn(s) \rightarrow Cd(s) + Sn^{2+}(aq)$.
D. $Cu^{2+}(aq) + Cd(s) \rightarrow Cu(s) + Cd^{2+}(aq)$.

29. A salt bridge in a Galvanic (Electrochemical) cell allows:
A. the passage of electrons through the salt bridge.
B. free mixing of the reactants in each half cell.
C. movement of ions towards each half cell.
D. the formation of precipitates in each half cell.

30. A student set up the following Galvanic cell. The student noted that the Cu electrode was connected to the positive terminal of the voltmeter when the cell was operational. This indicated that the Cu electrode was:
A. positive, and oxidation was occurring here.
B. positive, and reduction was occurring here.
C. negative, and oxidation was occurring here.
D. negative, and reduction was occurring here.



31. Iron is sometimes coated in a thin layer of zinc.
The purpose of the coating is:
A. to make the metal stronger.
B. to increase the conductivity of the metal.
C. to make the metal easier to polish.
D. to prevent corrosion of the metal.

32. Four of the most significant issues relating to the environment are:
(i). Acidity of rain water. (ii). Greenhouse Effect. (iii). Ozone Depletion. (iv). Photochemical Smog.

Carbon Dioxide in the atmosphere is thought to contribute to:
A. I, II and III. B. I, III and IV. C. I and II. D. II only.

33. Which of the following gases does NOT contribute to atmospheric pollution:
A. nitrogen. B. nitrogen dioxide. C. carbon monoxide. D. carbon dioxide.

34. Which of the following methods could NOT be used to prepare Carbon Dioxide.
A. add Hydrochloric acid to Calcium Carbonate (limestone).
B. add Sulfuric acid to Sodium Hydrogen Carbonate (baking soda).
C. add Potassium Hydroxide to Sodium Carbonate.
D. heat Calcium Carbonate (limestone).

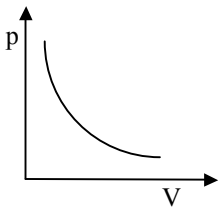
35. Which of the following gases will turn limewater milky:
A. hydrogen. B. oxygen. C. ozone. D. carbon dioxide.

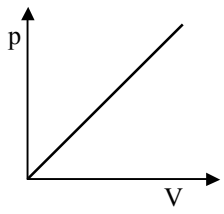
36. Photosynthesis plays an essential role in the composition of the atmosphere because:
A. plants use this process to convert glucose and oxygen into carbon dioxide and water.
B. without it, our atmosphere would be lacking in oxygen.
C. without it, our atmosphere would become filled with Photochemical Smog.
D. plants are able to replenish our atmosphere with water vapour.

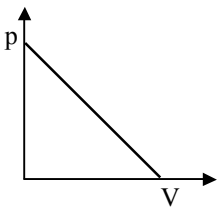
37. In the Fermentation process, enzymes in yeast convert:
A. glucose into starch. B. glucose to ethanol and carbon dioxide.
C. carbon dioxide and water to glucose. D. glucose to carbon dioxide and water.

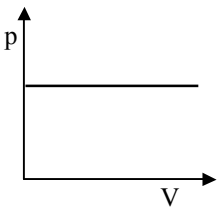
38. Charle's Law states that:
A. pressure in inversely proportional to Volume. B. Volume is proportional to the amount.
C. volume is proportional to Temperature. D. pressure is the sum of the partial pressures of each gas.

39. Which one of the following graphs represents the relationship between Pressure and Volume at a constant Temperature:

A. 

B. 

C. 

D. 

40. 3.2 g of Oxygen is pumped into an empty 1000 mL container. If the temperature inside the container is 50 ^{o}C, the pressure will be:
A. 268 kPa. B. 2.68 x 10^{-4} kPa. C. 3.73 x 10^{-3} kPa. D. 4.16 x 10^{-4} kPa.

41. Heating a gas at constant pressure from 10 ^{o}C to 100 ^{o}C results in the volume being:
A. unchanged. B. increased by a factor of 1.32.
C. doubled. D. increased by a factor of 10.

42. One mole of any gas always occupies:
A. a volume of 1.0 L. B. 22.4 L. C. 24.45 L. D. a fixed volume at SLC.

43. Which of the following is NOT explained by the Kinetic Molecular Theory?
A. a bicycle tyre becomes harder to pump up as it is filled. B. a hot air balloon rises after the burner is lit.
C. a sponge ball is compressed when it is squeezed. D. carbon dioxide is more soluble than oxygen in water.

44. Which one of the following correctly lists gases in DESCENDING order of reactivity:
A. nitrogen, carbon monoxide, argon, carbon dioxide. B. oxygen, carbon dioxide, nitrogen, carbon monoxide.
C. nitrogen, argon, carbon monoxide, nitrogen monoxide. D. carbon dioxide, carbon monoxide, nitrogen, argon.

45. One mol of a gas has a mass of 34 g. If 3.0 x 10^{23} molecules of the gas are taken, which one of the following statements MUST be true?
A. the mass taken is 3.4 g. B. 1.12 L of the gas was taken. C. the Mr of the gas is 68. D. there is 0.05 mol of the gas.

46. 10.0 L of a gas in a metal cylinder at a pressure of 1.00 atmosphere was heated from 350 K to 700 K. The pressure of the gas at 700 K would be:
A. 0.500 atm. B. 2.00 atm. C. 10.0 atm. D. 350 atm.

47. The Gas Laws would be least accurate in predicting the behaviour of a gas such as Oxygen at:
A. low temperatures and high pressures. B. low temperatures and low pressures.
C. high temperatures and high pressures. D. high temperatures and low pressures.

48. The purpose of the catalyst Manganese Dioxide in the decomposition of Potassium Chlorate is to:
A. react chemically with the Potassium Chlorate. B. increase the temperature of the reaction.
C. decrease the rate of reaction. D. increase the rate of reaction.

49. Gaseous Carbon Disulfide burns in Oxygen according to the equation: $CS_2(g) + 3\ O_2(g) \rightarrow CO_2(g) + 2\ SO_2(g)$. How many grams of Oxygen will react with 0.100 mol of CS_2?

A. 0.00900 g. B. 1.07 g. C. 3.20 g. D. 9.60 g.

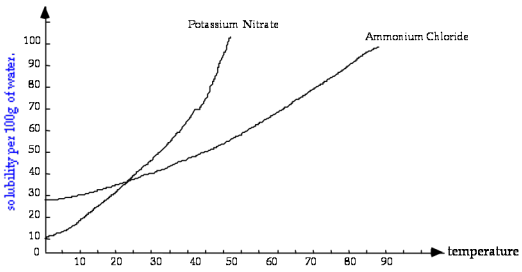
50. Aluminium can be produced from Alumina (Al_2O_3) and Carbon according to the equation:
$2\ Al_2O_3(l) + 3\ C(s) \rightarrow 3CO_2(g) + 4\ Al(l)$. If 0.40 mol of Al_2O_3 is reacted with excess Carbon, the number of mole of Carbon Dioxide produced would be:

A. 0.27 mol. B. 0.40 mol. C. 0.60 mol. D. 3.0 mol.

SECTION B: Where Applicable, answer in complete sentences and show all working and the correct units in calculations.

1. a). What type of bonds must be broken in a Sodium Fluoride crystal if it is to dissolve?
b). What type of bonds are formed between water molecules and Na^+ ions?
c). What type of bonds form between adjacent water molecules?

Use the following Solubility Curve to answer the following question.



2. a). Determine the temperature required to dissolve 30 g of Ammonium Chloride in 50 g of water.
b). Determine the mass of Potassium Nitrate that would be needed to produce 100 mL of a Saturated solution at 40 °C.

3. a). With the aid of a diagram, explain why ice is less dense than liquid water.
b). Water has a high heat of vapourisation (approx. 10 x larger than steel). Suggest one significance of this high heat of vapourisation for living things.

4. 88.0 g of solid dry ice (CO_2) is heated and vapourised. At a pressure of 780 mmHg and a temperature of 60 °C, what volume would this mass of CO_2 occupy?

5. Write balanced MOLECULAR equations for the following reactions (include all states):
a). The addition of Nitric Acid solution to solid Sodium Carbonate.
b). The addition of Magnesium metal to dilute Sulfuric acid.
c). The neutralisation of Hydrochloric acid, (HCl) solution by Calcium Hydroxide, ($Ca(OH)_2$) solution.

6. Write balanced IONIC equations to explain these statements (including subscripts/states):
a). Hydrofluoric acid, HF(aq) is a strong acid.
b). Ammonia, $NH_3(aq)$ is a weak base.
c). Sulfuric acid, $H_2SO_4(aq)$ is neutralised by KOH(aq).
d). Sulfuric acid, $H_2SO_4(aq)$ is diprotic (use 2 equations).
e). the HSO_4^- ion is amphiprotic (use 2 equations).

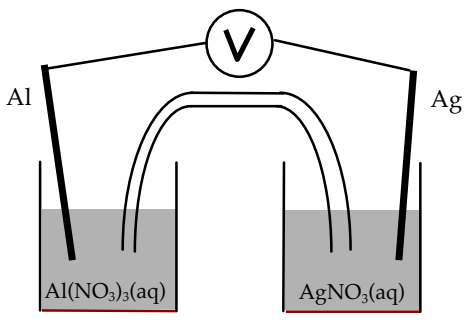
7. Write an equation for the: (i). Oxidation process. (ii). Reduction process. (iii). Redox reaction for:
a). Magnesium metal is oxidised to Magnesium ions by a solution of $Ag^+(aq)$ which is reduced to Ag(s).
b). Iron is oxidised to $Fe^{2+}(aq)$ by a water, $H_2O(l)$ and Oxygen, $O_2(g)$ which together are converted to Hydroxide ions, $OH^-(aq)$.
c). Aluminium metal is added to a blue solution containing $CuSO_4(aq)$. The solution is slowly decolourised and a red coating forms on the Aluminium.

8. Aluminium can be produced by electrolysis (opposite type of reaction to a Galvanic Cell) according to the equation:
$2\ Al_2O_3(l) + 3\ C(s) \rightarrow 3\ CO_2(g) + 4\ Al(l)$.
a). find the mass of Carbon required to produce 100 g of Aluminium.
b). find the volume of Carbon Dioxide produced at 38 °C and 0.981 atm pressure if 12.5 kg of Al_2O_3 is fully decomposed.

9. Ammonia burns in Oxygen in the absence of a catalyst according to the equation: $4NH_3(g) + 3\ O_2(g) \rightarrow 2\ N_2(g) + 6\ H_2O(l)$.
If all measurements are at 40 °C and 101.3 kPa pressure, determine the:
a). volume of Oxygen required to just react with 200 mL of Ammonia.
b). volume of Nitrogen produced from 200 mL of Ammonia.
c). change in volume due to the reaction.

10. Copper can react in the presence of concentrated Sulfuric acid according to the equation:
$Cu(s) + 2\ H_2SO_4(aq) \rightarrow CuSO_4(aq) + SO_2(g) + 2\ H_2O(l)$. What mass of Copper will react with 15.56 mL of 12.1 M H_2SO_4?

11. Consider the following Galvanic cell setup. The voltmeter shows that electrons pass from the Aluminium electrode to the Silver electrode and that the cell EMF is 0.93 V.



a). Write half equations for the reactions occurring in each beaker.
b). Write a balanced cell equation.
c). Indicate on the diagram the movement of electrons in the External circuit.
d). Which is the POSITIVE electrode?
e). Which electrode is the ANODE?
f). Indicate on the diagram the movement of ANIONS.
g). What is the name given to the process occurring at the ANODE?
h). What chemical does the Salt Bridge usually contain and what are 2 functions of the salt bridge?

12. Calculate the mass of each of these samples of Carbon Dioxide gas:
a). 0.25 mol of CO_2.
b). 1.5 L of CO_2 at 100 ^oC and 101.3 kPa.
c). 1.8 x 10^{23} molecules of CO_2. d). 2.24 L of CO_2 at STP.
e). 500 mL of CO_2 at -3 ^oC and 740 mmHg.
f). 2.45 mL of CO_2 at SLC.

13. Calculate the amount of substance:
a). in 243 g of Magnesium solid.
b). in 2.5 L of 2.05 M HCl solution.
c). 20.08 mL of 0.105 M HCl solution.
d). of C atoms in 0.50 mol of butane, C_4H_{10}.
e). of water molecules in a sample of 4.5 x 10^{21} molecules.

14. The lower atmosphere of planet earth contains approximately 78.9 % Nitrogen, 20.95 % Oxygen and small amounts of other gases including 0.035 % Carbon Dioxide by volume.
a). An increased level of Carbon Dioxide as well as increases in the levels of other gases has produced concern for scientists and the general population, known as the Greenhouse Effect. Briefly state reasons for their concern.
b). State one human activity responsible for an increase in the levels of CO_2.
c). What is the process performed by green plants that consumes CO_2. Write an equation for the reaction.

15. Predict the products in the following cell setups but if no reaction occurs, write NR:
a). Half cell with a Silver electrode and $AgNO_3$(aq) electrolyte is connected to a half cell with an Iron electrode and $FeCl_2$(aq) electrolyte.
b). Half cell with an inert electrode such as Carbon and NaCl(aq) electrolyte is connected to a half cell with an inert electrode and $FeCl_2$(aq) electrolyte.
c). Half cell with a Lead electrode and $Pb(NO_3)_2$(aq) electrolyte is connected to a half cell with a Zinc electrode and $ZnCl_2$(aq) electrolyte.

16. Using the answers from Question 15, write and Overall cell equation for the reactions that occurred.

ANSWERS: Section A: 1. C. 2. D. 3. D. 4. C. 5. B. 6. D. 7. B. 8. C. 9. D. 10. C. 11. D. 12. C. 13. C. 14. D. 15. D. 16. C. 17. A. 18. D. 19. C. 20. B. 21. A. 22. A. 23. C. 24. D. 25. C. 26. B. 27. A. 28. D. 29. C. 30. B. 31. D. 32. C. 33. A. 34. C. 35. D. 36. B. 37. B. 38. C. 39. A. 40. A. 41. B. 42. D.. 43. D. 44. D. 45. D. 46. B. 47. A. 48. D. 49. D. 50. C.
Section B: 1a). Ionic. b). Ion-dipole. c). Hydrogen Bonds. 2a). 48 ºC. b). >80 g. 3. a). When water freezes, the air is trapped between the water molecules that are joined together with H bonds. b). Water forms H bonds with 4 other water molecules so it will require more energy to break the bonds and therefore cause water to evaporate (leave the body of the liquid). 4. 53.24 L. 5. a). 2 HNO_3(aq) + Na_2CO_3(s) --> 2 $NaNO_3$(aq) + H_2O(l) + CO_2(g). b). Mg(s) + H_2SO_4(aq) --> $MgSO_4$(aq) + H_2(g). c). 2 HCl(aq) + $Ca(OH)_2$(aq) --> $CaCl_2$(aq) + 2 H_2O(l). 6. a). HF(aq) + H_2O(l) --> F^-(aq) + H_3O^+(aq). b). NH_3(aq) + H_2O(l) <==> NH_4^+(aq) + OH^-(aq). c). 2 KOH + H_2SO_4(aq) --> K_2SO_4(aq) + 2 H_2O(l). d). H_2SO_4(aq) + H_2O(l) --> HSO_4^-(aq) + H_3O^+(aq) then HSO_4^-(aq) + H_2O(l) <==> SO_4^{2-}(aq) + H_3O^+(aq). e). HSO_4^-(aq) + H_2O(l) <==> SO_4^{2-}(aq) + H_3O^+(aq) and HSO_4^-(aq) + H_2O(l) <==> H_2SO_4(aq) + OH^-(aq). 7. a). Oxi: Mg(s) --> Mg^{2+}(aq) + 2 e^-, Red: Ag^+(aq) + e^-(aq) --> Ag(s). Redox: Mg(s) + 2 Ag^+(aq) --> Mg^{2+}(aq) + 2 Ag(s). b). Oxi: Fe(s) --> Fe^{2+}(aq) + 2 e^-. Red: O_2(g) + 2 H_2O(l) + 4 e^- ---> 4 OH^- (aq). Redox: 2 Fe(s) + O_2(g) + 2 H_2O(l) ---> 2 $Fe(OH)_2$(s). Oxi: Al(s) --> Al^{3+}(aq) + 3 e^-. Red: Cu^{2+}(aq) + 2 e^- --> Cu(s). Redox: 2 Al(s) + 3 Cu^{2+}(aq) --> 2 Al^{3+}(aq) + 3 Cu(s). 8. a). 33.3 g. b). 4.78 x 10^3 L. 9. a). 150 mL. b). 100 mL. c). 250 mL. 10. 5.98 g. 11. a). Al: Al(s) --> Al^{3+}(aq) + 3 e^-. Ag: Ag^+(aq) + e^- --> Ag(s). b). Al(s) + 3 Ag^+(aq) --> Al^{3+}(aq) + 3 Ag(s). c). From Al to Ag. d). Ag. e). Al. f). Towards Al half cell. g). Oxidation. g). KNO_3, complete circuit and allow movement of ions to balance charges in half cells. 12. a). 11 g. b). 2.16 g. c). 13.2 g. d). 4.4 g. e). 1.0 g. f). 4.4 x 10^{-3} g.
13. a). 10.0 mol. b). 5.1 mol. c). 2.11 x 10^{-3} mol. d). 2.0 mol. e). 7.5 x 10^{-3} mol. 14. a). Global warming. b). Combustion, Respiration. c). Photosynthesis, 6 CO_2(g) + 6 H_2O(l) --> $C_6H_{12}O_6$(aq) + 6 O_2(g) in the Chlorophyll and required sunlight. 15. a). Ag(s), Fe^{2+}(aq). b). NR. c). Pb(s), Zn^{2+}(aq).
16. a). 2 Ag^+(aq) + Fe(s) --> Fe^{2+}(aq) + 2 Ag(s). c). Pb^{2+}(aq) + Zn(s) --> Pb(s) + Zn^{2+}(aq).